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10/728,706	12/05/2003	Kang-Hyun Lee	OPP 031367 US	9971

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EXAMINER

NGUYEN, TUAN H

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2813

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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GROUP 2800

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/728,706
Filing Date: December 05, 2003
Appellant(s): LEE, KANG-HYUN

Andrew D. Fortney, Ph.D.
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 11/30/06 appealing from the Office action mailed 6/23/06.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,750,150	Chung et al.	6-2004
6,6383,942	Narita et al.	5-2002

Background of the invention, pages 1-2 of the Appellant's application.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3, 4, 18, 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Background of the invention in view of Chung et al. (cited ref.).

Background of the invention, pages 1-2 discloses the conventional general metal line fabrication method including the steps of forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed; and then forming an aluminum metal layer on the insulation layer (paragraph [0007]); forming a photoresist pattern having openings of certain width on the aluminum metal layer; and selectively removing the aluminum metal layer at a lower side of the openings by dry etching to form a plurality of metal lines (paragraph [0008]).

Background of the invention fails to teach the formation of buffer layer on the photoresist pattern, including in the openings, for protecting the photoresist pattern from an etchant so that the thickness of photoresist pattern needs not to be increased in forming openings having a critical dimension of less than 0.23 micron (paragraphs [0010]-[0012]).

Chung et al., in a related method for reducing dimensions between patterns on a photoresist as shown in figs. 1-3 and text on col. 1-4, teaches the use of buffer layer 150 of oxide film of PE family (col. 3, last two paragraphs) on the photoresist pattern 130 for a subsequence of etching to form an opening having a width of less than 0.26 micron (i.e. 0.02 micron, col. 3, lines 44-46). The use of buffer layer would enhance the etching resistance of the photoresist pattern, allowing the photoresist layer having a lower thickness as required in the conventional method for forming opening having a critical dimension of less than 0.23 micron (col. 1, lines 5-40).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used buffer layer on the photoresist pattern as suggested by Chung et al. in the conventional process of forming metal line in the Background of the invention since it would enhance the etch resistance of the photoresist, increase the precision of patterning and defining of the photoresist, reducing the dimension of the opening, lower the photoresist thickness (col. 1, lines 22-40).

With respect to the thickness, it would have been obvious to those skilled in the art to recognize the photoresist thickness of less than 9000 angstroms is inherently required in forming opening of 0.02 micron with precision as disclosed by Chung et al.

It would also have been obvious to one having ordinary skill in the art at the time the invention was made to have selected a suitable thickness for photoresist layer and buffer layer as claimed in order to obtain the optimum result. The thickness ranges are considered to involve routine optimization.

Claims 2, 5-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Background of the invention in view of Chung et al. as applied to claims 1, 3, 18, 20-22 above, and further in view of Narita et al. (cited ref.).

The combination of Background of the invention and Chung et al. fails the teach the use of organic ARC between the metal layer and the photoresist pattern, and the metal layer comprises a lower metal layer of TiN/Ti as a barrier layer, an intermediate metal layer of Al-Cu alloy, and an upper metal layer of TiN/Ti as a capping layer.

Narita et al., in a related dry etching method as shown in figs. 15-22 and text on col. 9-14, teaches the formation of metal layer 13 including the lower metal layer 13d of TiN/Ti as an barrier layer (col. 11, first paragraph), intermediate metal layer of Al-Cu alloy 13a (col. 11, first paragraph), upper metal layer 13b of TiN/Ti (col. 8, fifth paragraph) on the insulating layer 12; forming an organic ARC layer 13c on the metal layer 13 (col. 12, lines 44-45); forming a photoresist pattern 17 having an opening of certain width on the metal layer 13 for a subsequent etching the metal layer 13 by dry etching using Cl_2/BCl_3 as an etching gas (col. 11, first paragraph) to form a plurality of metal lines (figs. 22A-22D).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have replaced aluminum metal layer with a stacked film for forming metal lines by dry etching method using Cl_2/BCl_3 as an etching gas as suggested by Narita et al. in the combination of Background of the invention and Chung et al. process for preventing metal from being side-etched.

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Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

(10) Response to Argument

Appellant's argument in his brief, pages 15-19, paragraph bridging pages 24-25 regarding to the Appellant's Background is not prior art, contradicts to what has been disclosed in the instant specification, paragraphs [0006]-[0012] as "a conventional general metal line fabrication method" (emphasis added), and paragraph [0024] clearly reiterates the conventional process as disclosed in the previous paragraph [0011] in which the photoresist has to be formed at more than about 9000 Å when a metal line having a critical dimension (CD) of less than 0.23 μm is to be formed as "prior art".

Contrary to the Appellant's argument his Brief, page 19, last paragraph to page 20, first paragraph that "Chung is, in fact, silent with regard to any thickness of the photoresist pattern." or "Chung also appears to be silent with regard to any defect reduction effects of forming the layer of inorganic material over the pattern and defined photoresist layer.". In fact, Chung's Background of the invention, col. 1, lines 13-34 recognize the same problem confronted by the inventor, that is the problems associated with the use of thick as well as thin photoresist in the conventional photolithographic process for reducing dimensions in sub-micron semiconductor manufacturing processing, due to light sources with lower wavelengths used in a high-resolution photolithographic process, and shallow depth of focus of a high-resolution photolithographic process. "As a result, a photoresist layer having a lower thickness is required for conventional photolithographic methods (emphasis added). However, a photoresist layer having a lower thickness is susceptible to the subsequent etching steps (emphasis added) in a semiconductor manufacturing process. This relative

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ineffective resistance to etching reduces the precision of patterning and defining of a photoresist. These limitations prevent the dimensions of patterns on photoresist from being reduced." (col. 1, lines 26-34).

Chung teaches the use of "buffer" layer 150 over the pattern photoresist layer 130 having reduced thickness from the conventional photolithographic process to enhance the etching resistance of the pattern photoresist layer, and at the same time further reduce the opening between the photoresist pattern to less than 0.26 micron (col. 3, lines 44-46 discloses the opening is reduced to 0.02 micron) for the subsequent step of dry etching (col. 4, second paragraph) metal line 110 (col. 2, last line) having sub-micron width which is less than the width of the photoresist opening as in the instant claimed invention.

Since Chung discloses the requirement to use a photoresist having a lower thickness for conventional photolithographic process (col. 1, lines 26-28), and teaches the use of "buffer" layer to prevent the etchant from attacking the thin photoresist layer. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a buffer layer over the photoresist layer having reduced thickness as suggested by Chung in the prior art process as disclosed in the Background of the instant invention for eliminating the problems associated with the bad selectivity with the photoresist in the conventional process that would require increased in photoresist layer's thickness to more than 9000 angstroms in etching metal line having a critical dimension of less than 0.23 micron.

With respect to the Appellant's argument that "Chung appears to be silent with regard to any defect reduction effects of forming the layer of inorganic material over the patterned and defined photoresist layer." Since Chung's the metal lines 110 are successfully patterned by dry etching with precision based on the use of a "buffer" layer 150 over the thin photoresist pattern 130 to enhance the etch resistance to the photoresist pattern 130, and the dimensions between the patterned photoresist and the underlying patterned first layer 110 are reduced as in the instant claimed invention, it would have been obvious to those skilled in the art to recognize the problems such as metal bridge or metal stringer or notching phenomenon associated with the use of thick and thin photoresist as a mask without "buffer" layer for dry etching the underlying metal layer from the conventional process, are overcome by using "buffer layer" over the patterned photoresist having reduced thickness as suggested by Chung in combination with the prior art as is disclosed in the Background of the instant invention.

With respect to the Appellant's arguments regarding to Group I, II in his Brief, pages 20-25 that direct to the same invention, claim 1 recites a method for fabricating a metal line of a semiconductor including an opening width in photoresist pattern, the other claim 22 recites the opening width in photoresist through a ratio between the opening width in photoresist and its thickness, since the prior art in the Background of the invention, in particular paragraph [0011] of the instant specification discloses the conventional process of patterning with the use of photoresist having thickness of more than about 9000 angstroms as a mask in dry etching the metal underlying layer having a critical dimension of less than 0.23 micron, and since Chung reference in a process

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for patterning a metal layer having opening less than 0.23 micron, recognizes the problems associated with the use of thick and thin photoresist layer in the conventional photolithography, and suggests to use a "buffer" layer over a pattern photoresist having reduced thickness as in the instant claimed invention to cure the deficiencies. It would have been obvious to those skilled in the art to lower the photoresist thickness to less than 9000 angstroms from the conventional process and cover the thin photoresist with a "buffer" layer as suggested by Chung in the conventional process of etching metal line using photoresist pattern as disclosed in the Background of the instant invention.

Secondly, due to the limitations of the current photolithography with respect to resolution and depth of focus, in order to pattern the metal line having opening of less than 0.26 micron by dry etching with the use of "buffer" layer over the pattern photoresist having reduced thickness as the same as in the instant claimed invention, the thickness of photoresist layer must be within the claimed range (i.e. less than 9000 angstroms).

Moreover, the claimed photoresist thickness of less than 9000 angstroms from "more than about 9000 angstroms" from the prior art although do not overlap, obviousness may still exist if the ranges are close enough that one would not expect a difference in properties. In re Woodruff 16 USPQ 2d 1934 (Fed. Cir. 1990); Titanium Metals corps. v. Banner 227 USPQ 773 (Fed. Cir. 1985); In re Aller 105 USPQ 233 (CCPA 1955).

With respect to claims 2-4, Chung teaches the use of ARC layer 120 between the metal layer 110 and photoresist pattern 130 (col. 3, second paragraph); the "buffer"

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layer 150 comprises an oxide film of PE family having thicknesses "a", "b" that could be varied as desired (col. 3, next to last paragraph). The thickness range of the "buffer" layer as recited in claim 4 is considered to involve routine optimization while it has been held to be within the level of ordinary skill in the art.

With respect to the Appellant's argument regarding to Narita reference in his Brief, pages 30-33, particularly on page 32, last paragraph that "Narita appears to be silent with regard to forming a buffer layer on a photoresist pattern.", Narita is relied on for the teachings of a stacked metal including a lower metal barrier, an intermediate metal, an upper metal and a capping layer, and the gas used for dry etching the metal stack as recited in claimed 5-17, the rejection does not overcome by pointing out that one reference does not contain a particular teaching when the reliance for that teaching was on another reference. In re Lyons 150 USPQ 741.

With respect to the unexpected result, it is well settled that a patent can not be granted for an applicant's discovery of a result, even though it may be unexpectedly good, which would flow logically from the teaching of the prior art. In re Rau, 117 USPQ 215 (CCPA 1958). In this case, since Chung clearly discloses the use of buffer layer over a thin pattern photoresist as a mask in dry etching process for patterning the metal layer having opening of less than 0.26 micron as claimed, with the combination of buffer layer over a photoresist having a lower thickness as required by Chung in the conventional process as disclosed in the Background of the present invention, one of the skilled in the art would expect all problems such as metal stringers, notching

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associated with thick and thin photoresist in dry etching process for forming opening in metal layer would be inherently eliminated.

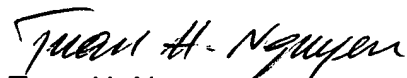
Appellant's arguments or conclusory statements unsupported by factual evidence are insufficient to establish unexpected results. In re Linder, 173 USPQ 356 (CCPA 1972).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

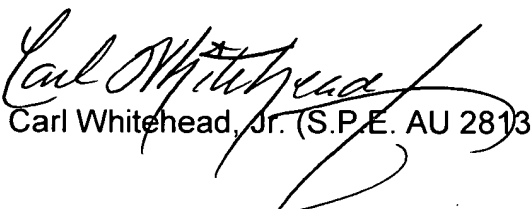
For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,


Tuan H. Nguyen
Primary Examiner
Art Unit 2813

Conferees:


David Blum (Quality Reviewer TC 2800)


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